

User's Manual

2406E Series Insulation Tester

Thank you for purchasing the YOKOGAWA 2406E Insulation Tester.

To optimize all the functions of the instrument, please read this manual thoroughly before operating it.

- Model -		
2406 31	2406 33	2406 35
2406 41	2406 43	2406 45
2406 32	2406 34	
2406 42	2406 44	

6th Edition : Jun. 2006 (KP)  
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YOKOGAWA

Yokogawa Meters & Instruments Corporation

IM 2406E-E  
7th Edition July 2007

1. Regarding Safe Use of This Product

- For the safe use of this product, the following safety symbols are used on the product concerned:
- Danger! Handle with Care.  
This symbol indicates that the operator must refer to an explanation in the user's manual in order to avoid risk of injury or death of personnel or damage to the instrument.
- High-voltage Terminal  
This symbol indicates a dangerous level of voltage (terminals fed from the interior by voltages exceeding 1000 volts must be so marked). Never touch the terminal.
- AC Voltage  
This symbol indicates that an AC voltage is present.
- WARNING**  
This indicates on the product that the operator must refer to an explanation in the user's manual in order to avoid the risk of serious injury or death of personnel. The manual describes how the operator should exercise special care to avoid electric shock or other dangers that may result in serious injury or the loss of life.
- CAUTION**  
This indicates on the product that the operator must refer to an explanation in the user's manual in order to avoid the risk of injury or damage to the product. The manual describes how the operator should exercise special care to avoid dangers that may result in injury or damage to the instrument.

- Always observe the following instructions. Failure to observe these instructions may result in electric shock hazards or other dangers that may lead to serious injury or the loss of life.

**WARNING**

1. During Measurement of Insulation Resistance

- A high voltage is present at the probes. Do not touch the device under test (DUT) or the EARTH, LINE or GUARD terminal.

2. During Measurement of AC Voltages

- Do not press the MEAS key while measuring AC voltages.
- An AC voltage is present at the GUARD terminal. Do not touch the terminal.

3. Immediately After Measurement of Insulation Resistance

- The probes or DUT may remain highly charged. Do not touch them immediately after the completion of measurement.

4. Probes

- Use the probes supplied with this tester by Yokogawa Meters & Instruments.
- Do not use probes that have deteriorated or broken.
- Remove the probes from the DUT before attaching/detaching the probes to/from the tester.

5. Insulation of Casing

- Punctures in the protective insulation may occur if there are any cracks or other damage in the casing as a result of the instrument having been dropped or hit against other objects. Do not use the instrument before any remedial measures are taken; ask the manufacturer for repair.

6. DUTs

- Turn off electrical power to the DUT before you begin measuring insulation resistance.
- Avoid touching any electrified part while using the tester around electrically live locations. For safety, it is recommended that you use a pair of rubber gloves or other alternative means.

7. Battery Replacement

- Remove the probes from the DUT and then turn off the range selector switch before you open the casing to replace the batteries.
- Do not touch the MEAS key during replacement. Otherwise, a high voltage may be produced.

8. Operating Environment

- Do not operate the tester in an atmosphere where any flammable or explosive gas is present.
- Do not use the tester if there is condensation on it.

9. Disassembly

- No person, except service personnel from Yokogawa Meters & Instruments, is authorized to disassemble this instrument.

- Always observe the following instructions. Failure to observe these instructions may result in electric shock hazards or other dangers that may lead to injury or damage to the instrument.

**CAUTION**

1. Measurement of AC Voltages

- Do not apply any voltage between terminals that exceeds the specified limit.

2. GUARD Terminal

- The GUARD terminal is an auxiliary measurement terminal to eliminate a leakage current. Do not apply any testing voltage to the terminal.

3. Ranges

- Do not switch between the rated voltages until two to three seconds have elapsed after the completion of each measurement. Switching between voltages immediately after the completion of measurement may result in possible damage to the tester or DUT due to the electrical charge at the probes or DUT. Note that the tester is provided with a discharge feature.

4. Power to DUTs

- Electrical charges may be present at metals or wiring cables attached to electrical equipment being tested. Verify that the equipment is free from electrical charges before connecting the testing terminals. The same rule applies to the grounding wire.

5. Range Selector Switch

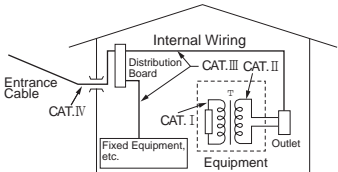
- Do not operate the range selector switch during testing.
- Do not apply any voltage to the testing terminals when measuring insulation resistance.

6. Batteries

- Do not mix batteries of different types or new batteries with used ones. If the tester will not be in service for a prolonged period, always remove the batteries before you store the instrument. If you store the tester with the batteries left installed, they are more likely to suffer fluid leakage, resulting in a malfunctioning of the instrument.

■ Measurement Categories

Measurement category		Description	Remarks
I	CAT. I	For measurements performed on circuits not directly connected to MAINS.	
II	CAT. II	For measurements performed on circuits directly connected to the low voltage installation.	Appliances, portable equipments, etc.
III	CAT. III	For measurements performed in the building installation.	Distribution board, circuit breaker, etc.
IV	CAT. IV	For measurements performed at the source of the low-voltage installation.	Overhead wire, cable systems, etc.



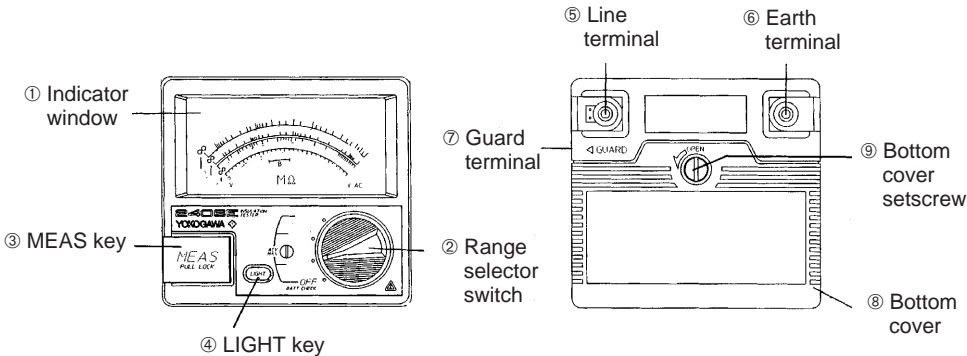
YOKOGAWA

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2. Components and Their Functions



- ① Indicator window

② Range selector switch  
Used to switch between the ranges for measuring insulation resistance and to select the OFF position (battery check).

③ MEAS key  
Used for insulation resistance measurements and battery checks.

④ LIGHT key  
Used to turn the lamp for the indicator window on or off.

⑤ Line terminal

⑥ Earth terminal

⑦ Guard terminal

⑧ Bottom cover

⑨ Bottom cover setscrew  
Used to replace batteries.

3. Measuring the Insulation Resistance

- Connecting the Probes **WARNING** Item 4  
Securely plug the line probe into the LINE terminal and the earth probe into the EARTH terminal.
- Disconnecting the Probes **WARNING** Item 4  
1. Make sure the range selector switch is off.  
2. Unplug the respective probes.
- Measuring the Insulation Resistance **WARNING** Items 1, 3 and 6; **CAUTION** Items 3, 4 and 5  
1. Adjust the range selector switch to the voltage (rated voltage) to be applied to the DUT.  
2. If the DUT is grounded, connect the earth probe clip to the DUT's ground line. If the DUT is not grounded, the earth probe clip may or may not be connected to the DUT's ground line.  
3. Bring the line probe into contact with the DUT, and then press the MEAS key. The pointer then indicates the insulation resistance of the DUT. During measurement, exercise care to prevent the leadwire of the line probe from coming into contact with the ground, floor or other object. Not observing this precaution may result in a failure to measure the correct insulation resistance.  
Upon completion of measurement, always turn the range selector switch off.  
4. Immediately after measurement, electrical charges resulting from the applied testing voltage may be present at the probes or DUT. The tester, therefore, is designed to automatically begin discharging electricity upon completion of measurement.

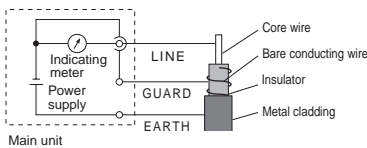
- Discharge Feature  
Any capacitive component in the DUT will be charged during measurement and thus the DUT remains electrified even after the completion of measurement, resulting in a hazardous condition.  
The tester is designed to begin discharging when the MEAS key is turned off. The pointer then swings to the position on the scale proportional to the voltage that has developed across the terminals. After measurement is completed, leave the probes connected until the pointer swings back to the infinity sign (∞) to allow the electricity in the DUT to fully discharge.

- Locking the MEAS Key **WARNING** Item 1  
The MEAS key, when pulled up to the right, can be locked with the key left turned on. Use this mechanism when making continuous measurement over a prolonged period. Note, however, that leaving the key turned on for an unreasonably long time will accelerate the discharge of the batteries.

- Measuring Only the Volumetric Resistance **WARNING** Item 1; **CAUTION** Items 2 and 4

For example, assume that you are doing an insulation test on a cable, as shown in the figure on the right.

If you bring a lead (optional) connected to the GUARD terminal into contact with an insulator overlapped by bare conducting wire, you can measure the volumetric resistance only. This is because the leakage current that flows along the surfaces of the insulator does not flow into the indicator. A dedicated lead (part number: 321803) is necessary when using the GUARD terminal.



4. Measuring AC Voltages ⚠️ **WARNING** Items 2 and 6; ⚠️ **CAUTION** Items 1 and 5

- The tester can also measure commercial-frequency AC voltages. When measuring insulation resistance, also use the tester to verify that there is no voltage present at the DUT.
1. Plug the probes in the same way as when measuring insulation resistance.
  2. Bring the line probe into contact with the location at which the AC voltage is being measured. Read the value on the voltage measurement scale (AC V). While you are measuring AC voltages, do not press the MEAS key.

5. Other Functions

• Lighting Up the Indicator Window (models 240641, 42, 43, 44 and 45 only)

Press the LIGHT key to turn on the scale plate lamp. Press the key once again to turn the lamp off. The lamp automatically turns off approximately 40 seconds after it has turned on.

6. Battery Check

1. Turn the range selector switch off and then press the MEAS key.
2. The batteries are still operable if the pointer is indicating anywhere within the range for a battery check (B mark).
3. The batteries are low if the pointer fails to stay within the range. Replace the batteries by following the instructions given in Section 7 below.

7. Battery Replacement ⚠️ **WARNING** Item 7; ⚠️ **CAUTION** Item 6

1. Make sure that the range selector switch is off.
2. Loosen the bottom cover setscrew with a coin or the like, and then slide the cover off of the main unit.
3. Remove all six batteries at one time and insert new ones with their polarities set exactly as shown on the battery holder.
4. After changing the batteries, replace the bottom cover and tighten the setscrew.

8. Maintenance

■ Storage Conditions

- Temperature/humidity: -10 to 60°C/70%RH maximum
- Avoid storing the tester in a location where there is: moisture, exposure to direct sunlight, a high-temperature heat source nearby, exposure to severe mechanical vibrations, a large amount of dust and/or salt, or a corrosive gas.

■ Removal of Dirt

Do not use volatile solvents (such as paint thinners or benzine) as they are likely to cause discoloration. Wipe off dirt with a cloth dampened water or alcohol.

■ Calibration Cycle

It is recommended that the tester be calibrated once every year for correct operation; ask Yokogawa Meters & Instruments to do the periodic calibration for you.

9. Specifications

● Insulation Resistance (Standard Test Conditions: Ambient Temperature = 23 ± 5°C; Relative Humidity = 45-75%)

Model	Rating	Central scale mark	First effective measuring range	Second effective measuring range	Low limit measuring resistance**	Rated current	AC-Voltage measuring range
240631	25 V/5MΩ	0.1MΩ	0.005-2MΩ	2MΩ (exclusive)-5MΩ	0.025MΩ	1 mA	0-300 V
240641*	50 V/10MΩ	0.2MΩ	0.01-5MΩ	5MΩ (exclusive)-10MΩ	0.05MΩ	1 mA	
	125 V/20MΩ	0.5MΩ	0.02-10MΩ	10MΩ (exclusive)-20MΩ	0.125MΩ	1 mA	
240632	125 V/20MΩ	0.5MΩ	0.02-10MΩ	10MΩ (exclusive)-20MΩ	0.125MΩ	1 mA	0-300 V
240642*	250 V/50MΩ	1MΩ	0.05-20MΩ	20MΩ(exclusive)-50MΩ	0.25MΩ	1 mA	
240633	125 V/20MΩ	0.5MΩ	0.02-10MΩ	10MΩ (exclusive)-20MΩ	0.125MΩ	1 mA	0-600 V
240643*	250 V/50MΩ	1MΩ	0.05-20MΩ	20MΩ (exclusive)-50MΩ	0.25MΩ	1 mA	
	500 V/100MΩ	2MΩ	0.1-50MΩ	50MΩ (exclusive)-100MΩ	0.5MΩ	1 mA	
240634	250 V/50MΩ	1MΩ	0.05-20MΩ	20MΩ (exclusive)-50MΩ	0.25MΩ	1 mA	0-600 V
240644*	500 V/100MΩ	2MΩ	0.1-50MΩ	50MΩ (exclusive)-100MΩ	0.5MΩ	1 mA	
	1000 V/2000MΩ	50MΩ	2-1000MΩ	1000MΩ (exclusive)-2000MΩ	1MΩ	1 mA***	
240635	250 V/500MΩ	10MΩ	0.5-200MΩ	200MΩ (exclusive)-500MΩ	0.25MΩ	1 mA***	0-600 V
240645*	500 V/1000MΩ	20MΩ	1-500MΩ	500MΩ (exclusive)-1000MΩ	0.5MΩ	1 mA***	
	1000 V/2000MΩ	50MΩ	2-1000MΩ	1000MΩ (exclusive)-2000MΩ	1MΩ	1 mA***	

- \* : denotes models with a scale plate lamp  
\*\* : denotes a value that allows the rated voltage to be maintained during testing  
\*\*\*: indicates that the value becomes 0.55 mA at the lower limit of the primary effective range of measurement.

Standard test conditions

- Ambient temperature and humidity : 23 ±5°C at 45 to 75% RH  
Attitude : Horizontal (within 5 degrees from horizontal)  
Influence of earth magnetism : Earth magnetic field  
Battery Voltage : Within effective range for the battery (When the battery is checked, the pointer must be within the B mark)

Tolerances under the above conditions

- Resistance measurement : ±5% of reading within the first effective measuring range  
±10% of reading within the second effective measuring range  
Infinity and zero indications : Up to 0.7% of scale length  
AC voltage : ±10% of the maximum value  
No load voltage : Within 130% of the rated voltage  
Rated measuring current : 1 mA for the first effective measuring range (-0 to +20%)  
Short-circuit current : 12 mA or less  
Scale length : Approx. 86 mm

- Response time : 3 sec or less untill the pointer is within tolerance from the instant the resistors whose values correspond to the midpoint and zero indications are connected abruptly.  
Friction : No friction is recognized.

- Effects of tilting : Deviation from the infinity indication when the tester is tilted or rotated by 30 degrees from the horizontal must be 2% or less of the scale length.

- Effect of temperature : Deviation from the midpoint indication at 20°C must be 5% or less when ambient temperature is varied from 20°C by ±20°C.  
0.7% or less of scale length for infinity and zero indications.

- Effect of humidity : Within tolerance when the tester is left for one hour with the humidity at 90% RH.  
Effect of external magnetic field : The change of indication must be 3% or less of the indicated value when an external field of DC 400A/m is applied in the most affected direction.

Effect of AC component of voltage at measurement terminals :

A change when a capacitor of 5μF ±10% is connected in parallel with a resistor corresponding to the midpoint indication connected, must be 10% or less of indication.

- Insulation resistance : 50MΩ or more between electric circuits and outer case, when tested at 500V if the rated measuring voltage is 500 V or less and at a voltage identical to the rated voltage if the rated voltage exceeds 500 V.

- Dielectric strength : 3700 V AC for one minute between the electric circuits and the outer case.  
Vibration proof : When a vibration frequency of 16.7 Hz and peak-to-peak amplitude of 4 mm are applied to the direction of the axis of the moving part, the specifications for tolerances, friction, and the effect of tilting must be met.

- Shock proof : When shock of 1000 m/s<sup>2</sup> is applied twice in the direction of axis of the moving part and the direction perpendicular to the axis, specifications for tolerance, friction, and effect of tilting must be met.

- Durability : When a resistor corresponding to the midpoint indication is connected across the measuring terminals and the power switch is repeatedly turned on and off 10,000 times at the rate of about 300 times/hour, the specifications for tolerance and friction must be met.

- Input mistake protection : When an AC voltage of 50 or 60Hz at 1.2 times the rated measuring voltage is applied to the measuring terminals for 10 seconds, no abnormality must occur.

- Operation temperature/humidity : 0 to 40°C/90%RH or less (no condensing)  
Storage temperature/humidity : -10 to 60°C/70%RH or less (No condensing; remove the battery).

- Battery : R6, AA 1.5 V (6 batteries)  
External dimensions : Approx. 120 × 110 × 60mm  
Weight : Approx. 500g (including batteries)  
Safety Standard : Complied Standard BS EN61010-1  
BS EN61010-2-31

- Insulation class II Double insulation  
Measurement category II  
Polution degree 2  
EMC Standard : Complied Standard EN55011 Group1 Class A  
EN61326



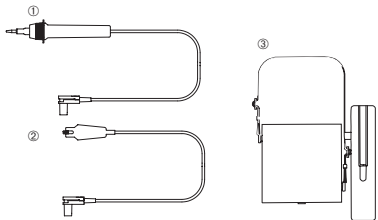
This product is class A for use in an industrial environment and may cause radio interference if used for domestic use.  
Therefore, appropriate measures must be taken when using it for domestic use.

Note

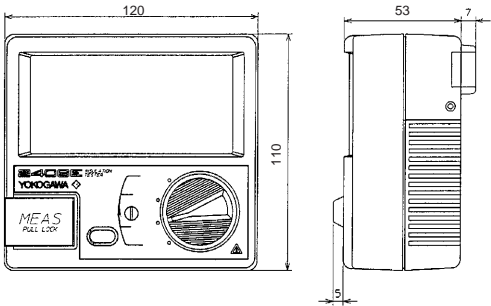
- The application of the following accessory could affect the safety and EMC performance of the product and such item should be used with this consideration.  
- Lead for guard terminal : 321803
- Interconnection with other apparatus is not recommended.

Supplied Accessories (the items labeled ① to ③ are spare parts)

Description	Model/PartNo.	Qt'y	Remarks
Batteries	R6P	6	Built-in (AA-size)
Earth and Line probe	98007		
① Line probe	B9204XD		
② Earth probe	B9204XJ		
③ Hard case	B9075UF (including a probe case)		
User's manual	IM2406E-E	1	This manual



■ External Dimensions



■ Notice Regarding The Manual

- The information contained in this manual is subject to change without notice.
- Every effort has been made to ensure that the information contained herein is accurate.  
However, should any concerns, errors, or omissions come to your attention, or if you have any comments, please contact us.
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